

Chapter 9 Brakes

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Specifications

Brake fluid type	See Chapter 1
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Disc brakes

Minimum brake pad thickness	See Chapter 1
Disc thickness after resurfacing	0.980 inch minimum
Disc discard thickness	0.965 inch*
Lateral runout	0.004 inch maximum
Disc thickness variation (parallelism)	0.0005 inch

* Refer to the marks cast into the disc. They supersede information printed here.

Drum brakes

Minimum brake lining thickness	See Chapter 1
Drum diameter after resurfacing	9.56 inch maximum
Drum discard thickness	9.59 inch*
Out-of-round	0.006 inch maximum
Taper	0.003 inch maximum

* Refer to the marks cast into the drum. They supersede information printed here.

Parking brake travel	9 to 13 clicks
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Torque specifications

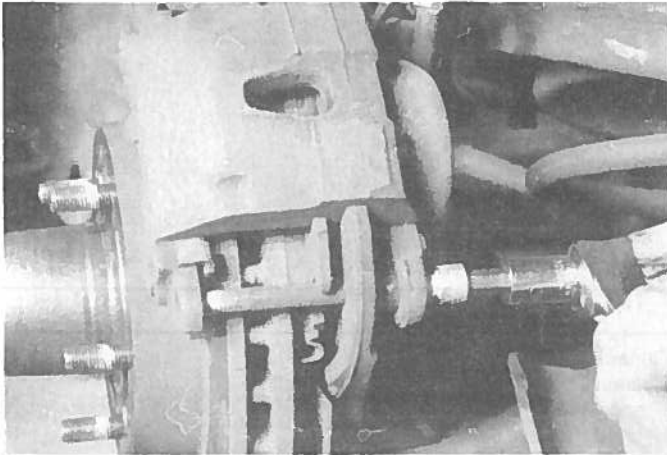
	Ft-lbs
Master cylinder mounting nuts	21
Power booster mounting nuts	21
Caliper mounting bolts	37
Wheel cylinder mounting bolts	13
Brake hose-to-caliper banjo bolt	32
Wheel lug nuts	See Chapter 1
Brake pedal shaft nut	28

1 General information

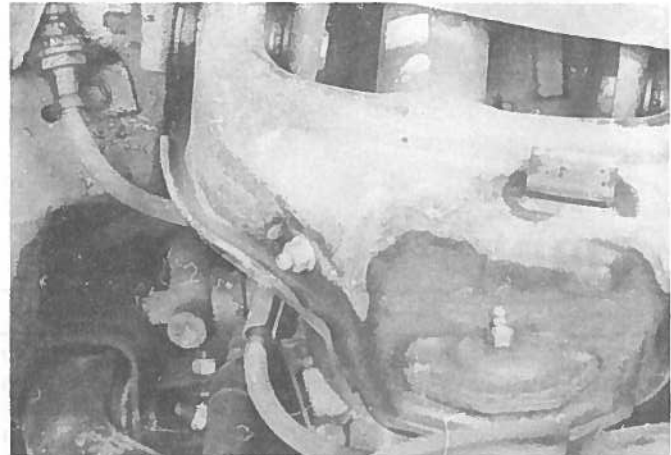
The vehicles covered by this manual are equipped with hydraulically operated front and rear brake systems. The front brakes are disc type and the rear brakes are drum type. Both the front and rear brakes are self-adjusting. The front disc brakes automatically compensate for pad wear, while the rear drum brakes incorporate an adjustment mechanism which

is activated as the brakes are applied when the vehicle is driven in reverse.

Later models are equipped with an Anti-lock Braking System (ABS). ABS is designed to maintain vehicle steerability, directional stability and optimum braking under most conditions. It does so by monitoring the speed of each wheel and controlling the brake pressure to each wheel during braking. All parts and procedures listed in this Chapter also apply to models with ABS. More information on the ABS, and the components which are unique to it, can be found in Section 16.



2.6a Use an Allen wrench to remove the two caliper mounting bolts. Check the bolt threads for damage



2.6b Remove the brake line retaining clip (mounted to the frame rail at the upper left) and separate the brake line from the retainer. Pull off the caliper and remove the inside pad from the caliper

Hydraulic system

The hydraulic system consists of two separate circuits. The master cylinder has separate reservoirs for the two circuits and in the event of a leak or failure in one hydraulic circuit, the other circuit will remain operative. A visual warning of circuit failure or air in the system is given by a warning light activated by displacement of the piston in the pressure differential switch portion of the combination valve from its normal "in balance" position.

Combination valve

A combination valve, located in the engine compartment below the master cylinder, consists of three sections providing the following functions. The metering section limits pressure to the front brakes until a predetermined front input pressure is reached and until the rear brakes are activated. There is no restriction at inlet pressures below 3 psi, allowing pressure equalization during non-braking periods. The proportioning section proportions outlet pressure to the rear brakes after a predetermined rear input pressure has been reached, preventing early rear wheel lock-up under heavy brake loads. The valve is also designed to assure full pressure to one brake system should the other system fail. The pressure differential warning switch incorporated into the combination valve is designed to continuously compare the front and rear brake pressure from the master cylinder and energize the dash warning light in the event of either a front or rear brake system failure. The design of the switch and valve are such that the switch will stay in the "warning" position once a failure has occurred. The only way to turn the light off is to repair the cause of the failure and apply the brake pedal firmly.

Power brake booster

The power brake booster, utilizing engine manifold vacuum and atmospheric pressure to provide assistance to the hydraulically operated brakes, is mounted on the firewall in the engine compartment.

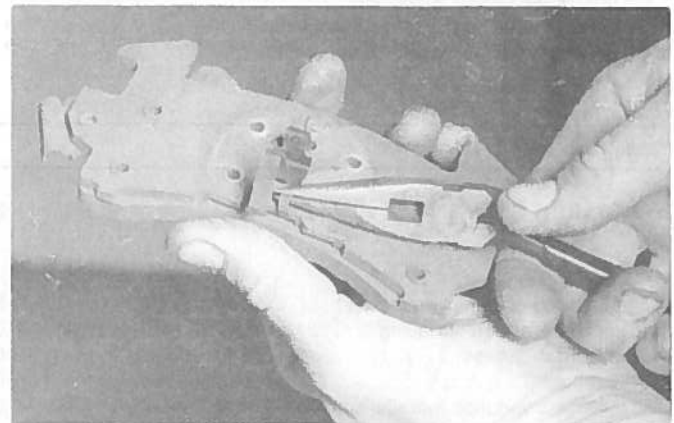
Parking brake

The parking brake operates the rear brakes only, through cable actuation. It's activated by a pedal mounted on the left side kick panel.

Service

After completing any operation involving disassembly of any part of the brake system, always test drive the vehicle to check for proper braking performance before resuming normal driving. When testing the brakes, perform the tests on a clean, dry flat surface. Conditions other than these can lead to inaccurate test results.

Test the brakes at various speeds with both light and heavy pedal pressure. The vehicle should stop evenly without pulling to one side or the other. Avoid locking the brakes because this slides the tires and diminishes braking efficiency and control of the vehicle.



2.6c Remove the anti-rattle clip with pliers

Tires, vehicle load and front-end alignment are factors which also affect braking performance.

2 Front disc brake pads – replacement

Refer to illustrations 2.6a thru 2.6k

1 Warning: Disc brake pads must be replaced on both wheels at the same time. Whenever you are working on the brake system be aware that asbestos dust may be present and be careful not to inhale any of it, because it has been proven to be harmful to your health. Never blow the dust out with compressed air, and wear an approved filtering mask when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner or clean brake fluid only!

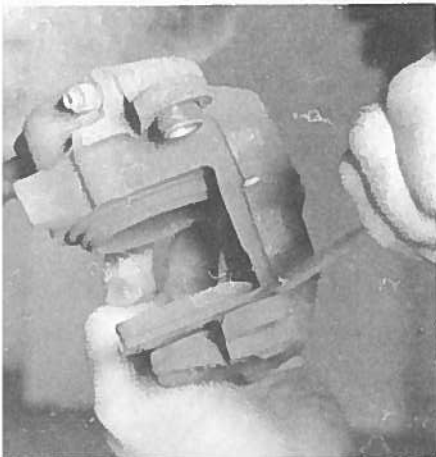
2 Remove the cover from the brake fluid reservoir and siphon off about two ounces of the fluid into a container and discard it.

3 Raise the front of the vehicle and place it securely on jackstands.

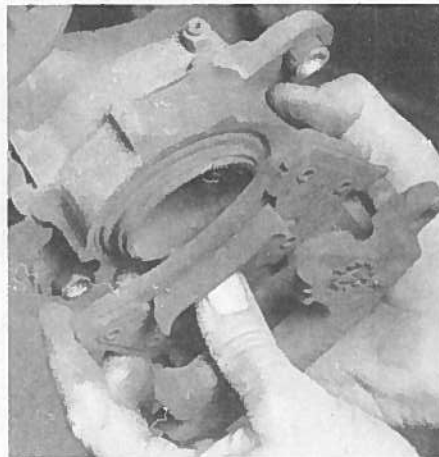
4 Remove the front wheel, then, on 4WD models, reinstall two wheel lugs (flat side toward the rotor) to hold the rotor in place. Work on one brake assembly at a time, using the assembled brake for reference if necessary.

5 Push the piston back into its bore. If necessary, a C-clamp can be used, but a flat bar will usually do the job. As the piston is depressed to the bottom of the caliper bore, the fluid in the master cylinder will rise. Make sure that it does not overflow. If necessary, siphon off more of the fluid as directed in Step 2.

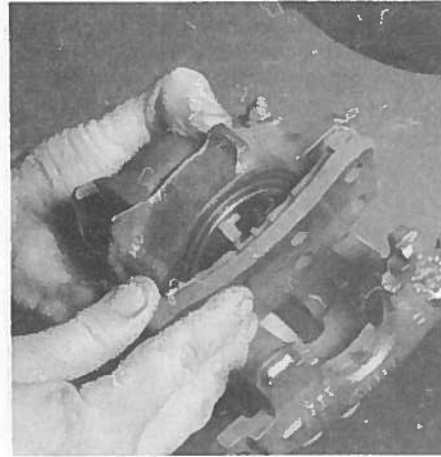
6 Now see the illustrations and perform the procedure described. Start with illustration 2.6a.



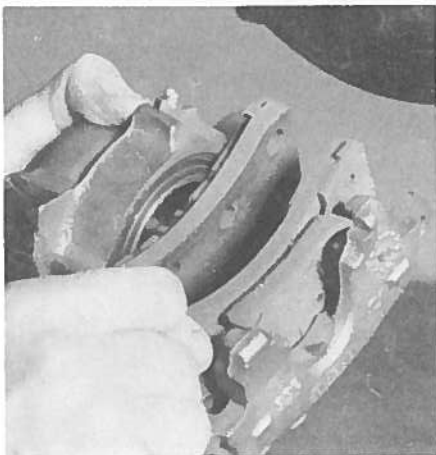
2.6d Use a screwdriver to detach the outer pad from the caliper



2.6e Separate the outer pad from the caliper



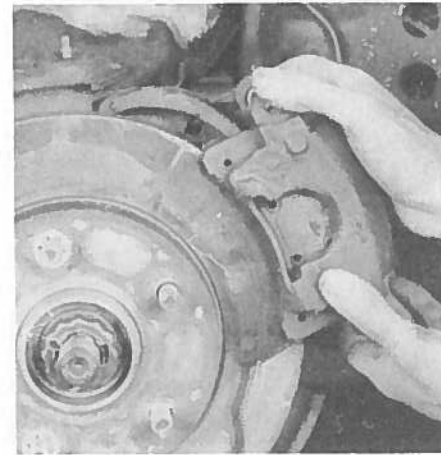
2.6f After cleaning the caliper, install the anti-rattle clip to the new pad and install the inner pad



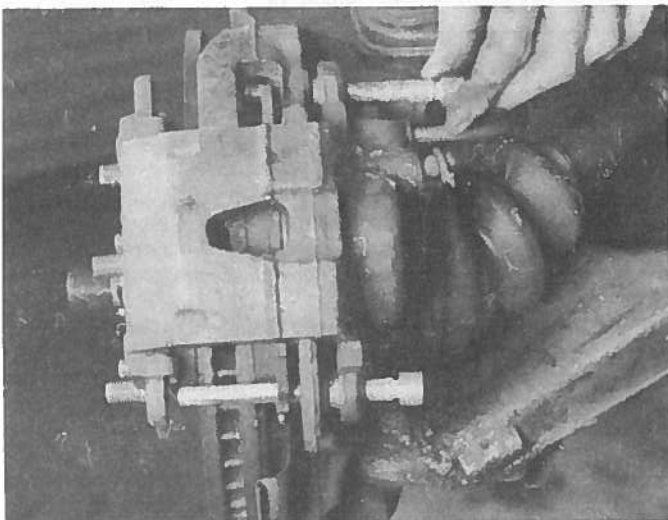
2.6g Attach the outer pad to the caliper



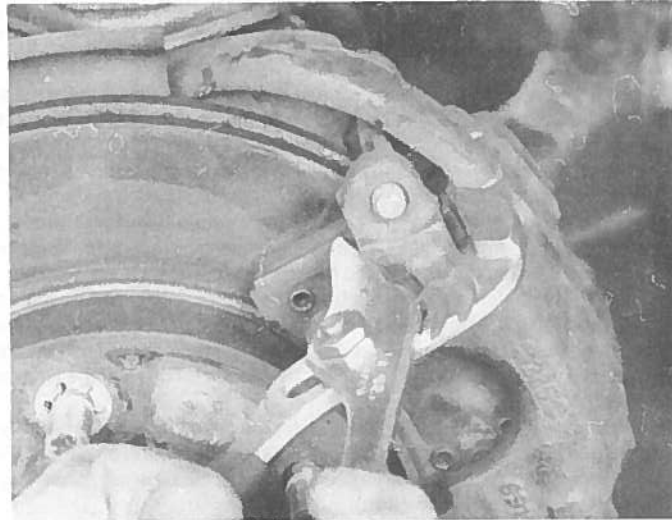
2.6h Apply multi-purpose grease to the ends of the caliper mounting bracket surfaces



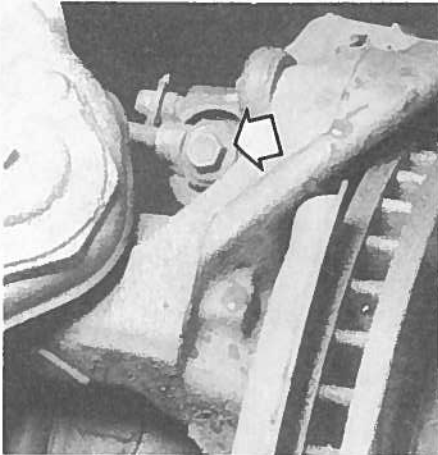
2.6i Install the caliper over the disc onto the mounting bracket. Do not get any grease on the pad linings



2.6j Install the mounting bolts and tighten them securely, then reattach the brake hose to the retaining clip on the frame



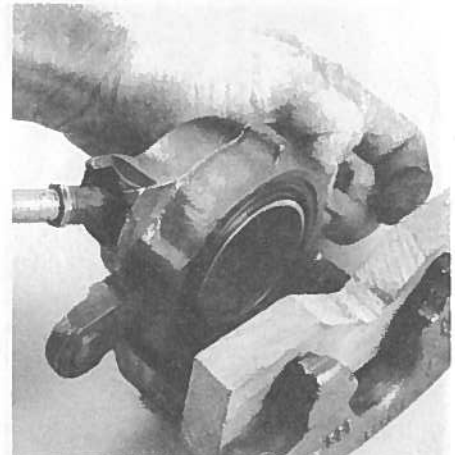
2.6k After refilling the master cylinder and pumping the brake pedal to seat the pad, use channel-lock pliers to bend the upper ears of the outer pad until the ears are flush with the caliper housing, with no radial clearance



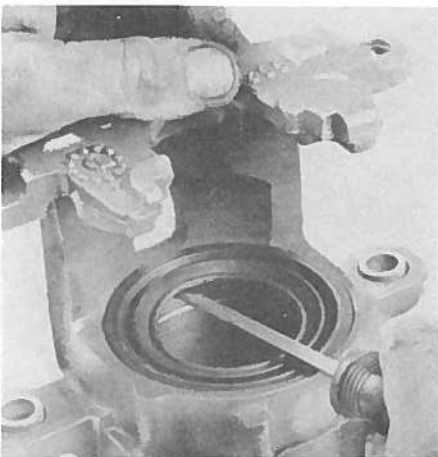
3.6a Remove the brake fluid hose banjo bolt (arrow)



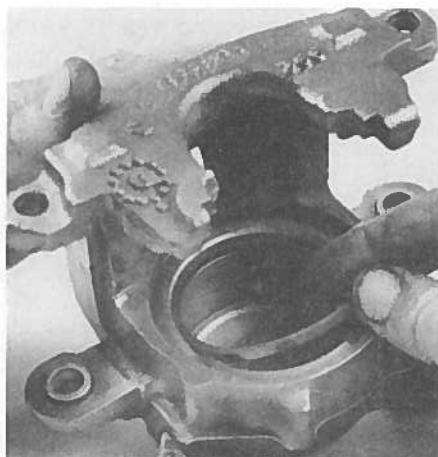
3.6b Always install new copper seal rings when installing the brake hose



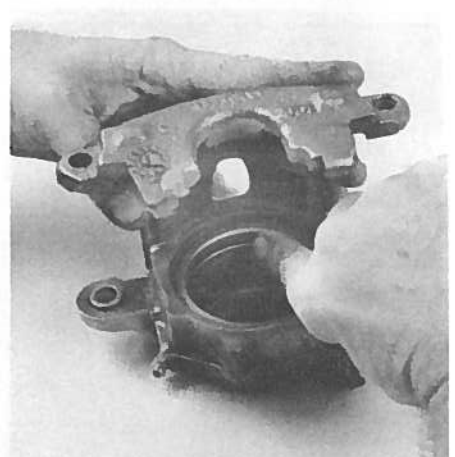
4.4 Compressed air is used to move the piston out of the caliper bore (use a wooden block as a cushion)



4.5 Pry the dust boot out of the caliper bore



4.6 Remove the piston seal from the caliper groove



4.10 Position the seal in the caliper bore groove

3 Front disc brake caliper – removal and installation

Refer to illustrations 3.6a and 3.6b

- 1 Whenever you are working on the brake system be aware that asbestos dust is present and be careful not to inhale any of it, because it has been proven to be harmful to your health.
- 2 Remove the cover from the brake fluid reservoir and siphon off about two ounces of the fluid into a container and discard it.
- 3 Raise the front of the vehicle and place it securely on jackstands.
- 4 Remove the front wheel. Remove the caliper from one brake assembly at a time, using the assembled brake for reference if necessary.
- 5 Push the piston back into its bore. If necessary, a C-clamp can be used, but a flat bar will usually do the job. As the piston is depressed to the bottom of the caliper bore, the fluid in the master cylinder will rise. Make sure that it does not overflow. If necessary, siphon off more of the fluid as directed in Step 2.
- 6 Remove the banjo fitting bolt holding the brake hose (see illustration), then remove and discard the copper seal rings found on either side of the banjo fitting. **Note:** Always use new copper seals when reinstalling the brake hose (see illustration).
- 7 Remove the Allen head bolts holding the caliper to the mounting bracket and separate the caliper from the rotor.
- 8 Installation is the reverse of removal. Lubricate the ends of the caliper mounting bracket surfaces before attaching the caliper to the bracket. Tighten all bolts securely.

4 Front disc brake caliper – overhaul

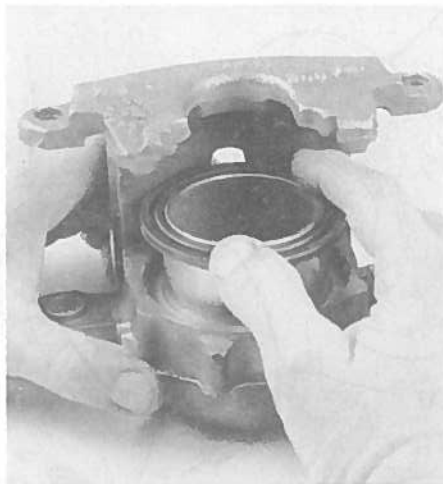
Refer to illustrations 4.4, 4.5, 4.6, 4.10, 4.11, 4.12 and 4.13

Note: Purchase a brake caliper overhaul kit for your particular vehicle before beginning this procedure. Complete overhauled calipers are available at many auto parts stores. These may be more cost effective, particularly if the piston or piston bore in the caliper is damaged.

- 1 Remove the caliper (see Section 3).
- 2 Remove the brake pad assemblies (see Section 2).
- 3 Clean the exterior of the brake caliper with brake fluid (never use gasoline, kerosene or cleaning solvents), then place the caliper on a clean workbench.
- 4 Place a wooden block or shop rag in the caliper as a cushion, then use compressed air to remove the piston from the caliper (see illustration). Use only enough air pressure to ease the piston out of the bore. If the piston is blown out, even with the cushion in place, it may be damaged. **Caution:** Never place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air – serious injury could occur.
- 5 Carefully pry the dust boot out of the caliper bore (see illustration).
- 6 Using a wood or plastic tool, remove the piston seal from the groove in the caliper bore. Metal tools may cause bore damage (see illustration).
- 7 Remove the caliper bleeder valve, then remove and discard the sleeves and bushings from the caliper ears. Also discard all rubber parts.
- 8 Clean the remaining parts with brake fluid. Allow them to drain and then shake them vigorously to remove as much fluid as possible.



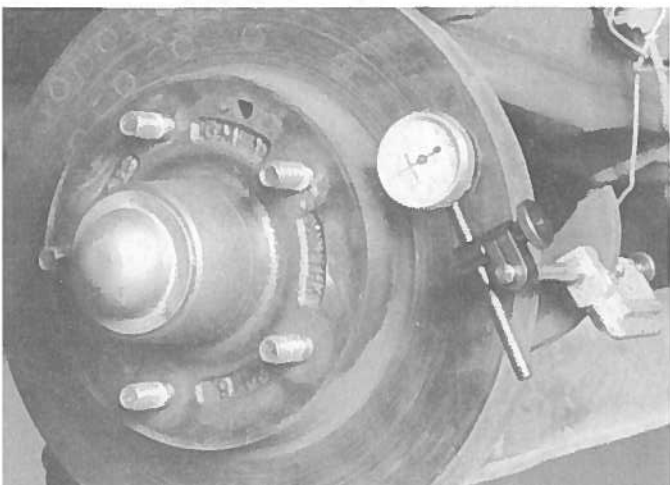
4.11 Install a new dust boot in the piston groove with the folds toward the open end of the piston



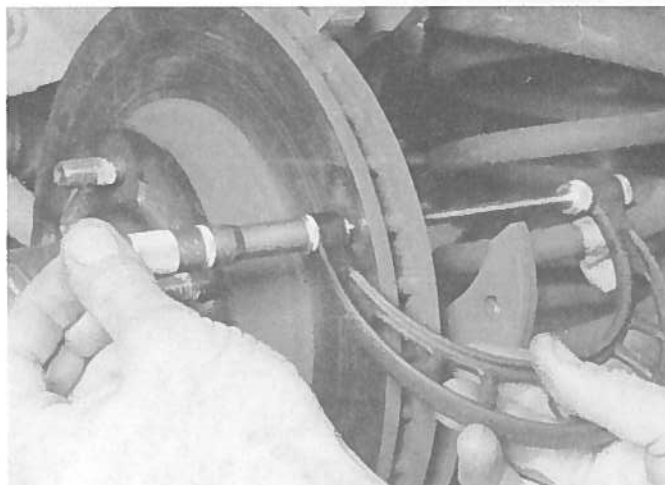
4.12 Square the piston in the bore



4.13 Use a hammer and driver to seat the boot in the caliper housing counterbore



5.5 Check the brake disc runout with a dial indicator



5.6 Check the disc thickness with a micrometer

9 Carefully examine the piston for nicks and burrs and loss of plating. If surface defects are present parts must be replaced. Check the caliper bore in a similar way, but polishing with crocus cloth is permissible to remove light corrosion and stains. Discard the mounting bolts if they are corroded or damaged.

10 When assembling, lubricate the piston bores and seal with clean brake fluid. Position the seal in the caliper bore groove (**see illustration**).

11 Lubricate the piston with clean brake fluid, then install a new boot in the piston groove with the fold toward the open end of the piston (**see illustration**).

12 Insert the piston squarely into the caliper bore, then apply force to bottom the piston in the bore (**see illustration**).

13 Position the dust boot in the caliper counterbore, then use a drift to drive it into position (**see illustration**). Make sure that the boot is evenly installed below the caliper face.

14 Install the bleeder valve.

15 The remainder of the installation procedure is the reverse of the removal procedure. Always use new copper gaskets when connecting the brake hose and bleed the system (see Section 13).

Inspection

1 Raise the vehicle and place it securely on jackstands.

2 Remove the appropriate wheel.

3 Remove the brake caliper assembly (see Section 3 or 5). **Note:** It is not necessary to disconnect the brake hose. After removing the caliper mounting bolts, hang the caliper out of the way on a piece of wire. Never hang the caliper by the brake hose because damage to the hose will occur.

4 Inspect the brake disc surfaces. Light scoring or grooving is normal, but deep grooves or severe erosion is not. If pulsating has been noticed during application of the brakes, suspect disc runout.

5 On 4WD models, reinstall two lug nuts with the bevelled sides facing out. This secures the disc for the following check. Attach a dial indicator to the caliper mounting bracket, turn the brake disc and note the amount of runout. Check both inner and outer surfaces (**see illustration**). If the runout is more than the maximum allowable, the disc must be removed from the vehicle and taken to an automotive machine shop for resurfacing. **Note:** Professionals recommend resurfacing of disc brakes regardless of the dial indicator reading (to produce a smooth, flat surface that will eliminate brake pedal pulsations and other undesirable symptoms related to questionable discs). At the very least, if you elect not to have the discs resurfaced, deglaze them with sandpaper or emery cloth (using a swirling motion to ensure a nondirectional finish).

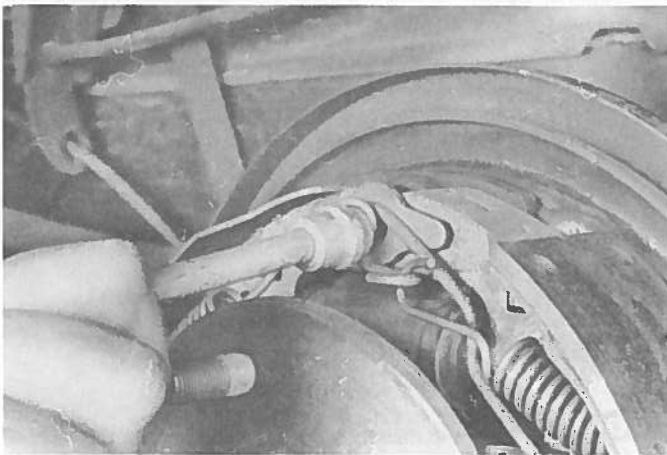
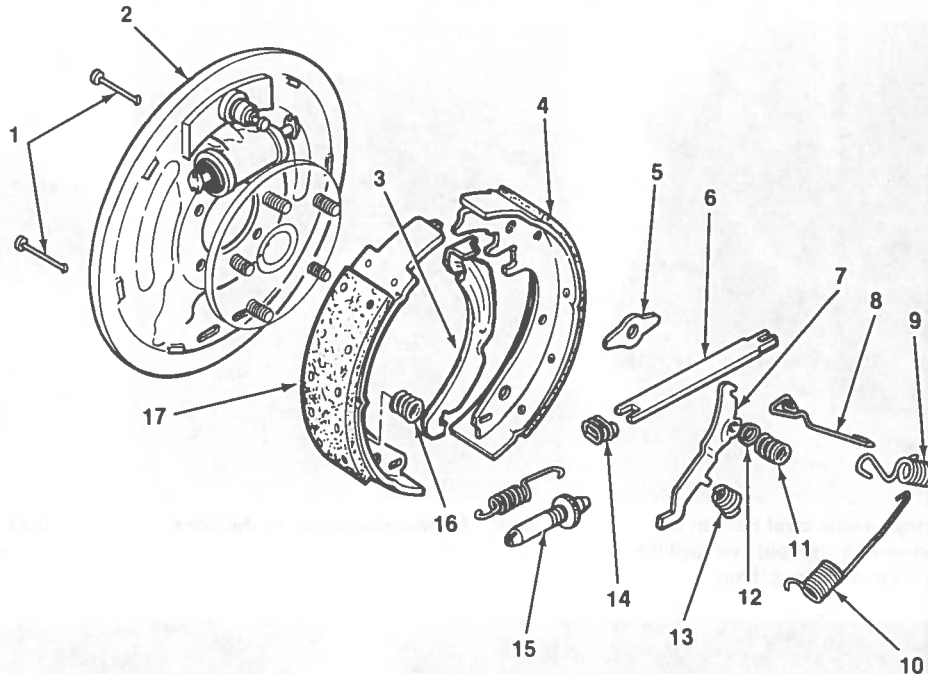
6 Using a micrometer, measure the thickness of the disc (**see illustration**). If it is less than the minimum specified, replace the disc with a new

5 Brake rotor (disc) – inspection, removal and installation

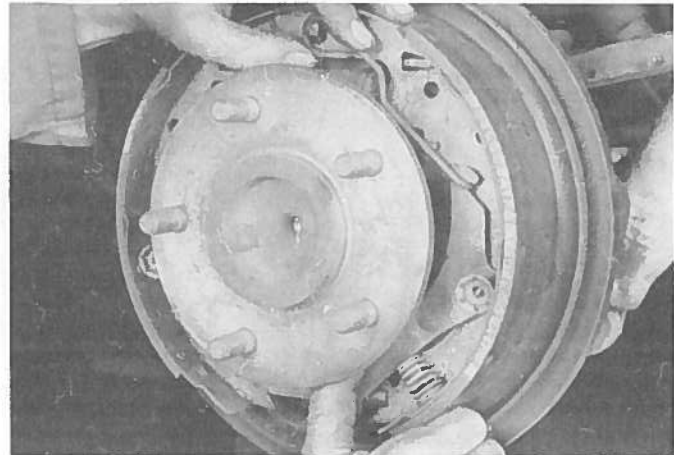
Refer to illustrations 5.5 and 5.6

6.4a Exploded view of the drum brake components

- 1 Hold-down pins
- 2 Backing plate
- 3 Parking brake lever
- 4 Secondary shoe
- 5 Shoe guide
- 6 Parking brake strut
- 7 Actuator lever
- 8 Actuator link
- 9 Return spring
- 10 Return spring
- 11 Hold-down spring
- 12 Lever pivot
- 13 Lever return spring
- 14 Strut spring
- 15 Adjusting screw assembly
- 16 Adjusting screw spring
- 17 Primary shoe



6.4b Remove the shoe return springs – the spring tool shown here is available at most auto parts stores and makes this job much easier and safer



6.4c Pull the bottom of the actuator lever toward the secondary brake shoe, compressing the lever return spring – the actuator link can now be removed from the top of the lever

one. Also measure the disc thickness at several points to determine variations in the surface. Any variation over 0.0005 inch may cause pedal pulsations during brake application. If this condition exists and the disc thickness is not below the minimum, the disc can be removed and taken to an automotive machine shop for resurfacing.

Removal and installation

7 To remove and install the disc on 2WD models, refer to Chapter 1, *Wheel bearing check and repack*. On 4WD models, the disc should pull off the studs after the caliper has been removed. There may be a Tinnerman nut over one of the studs that secures the disc. This does not need to be replaced when installing the disc.

6 Rear drum brake shoes – replacement

Refer to illustrations 6.4a through 6.4v

Warning: Drum brake shoes must be replaced on both wheels at the same time – never replace the shoes on only one wheel. Also, the dust created by the brake system may contain asbestos, which is harmful to

your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake cleaner or denatured alcohol only!

Caution: Whenever the brake shoes are replaced, the retractor and hold-down springs should also be replaced. Due to the continuous heating/cooling cycle that the springs are subjected to, they lose their tension over a period of time and may allow the shoes to drag on the drum and wear at a much faster rate than normal. When replacing the rear brake shoes, use only high quality nationally recognized brand-name parts.

1 Loosen the wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling.

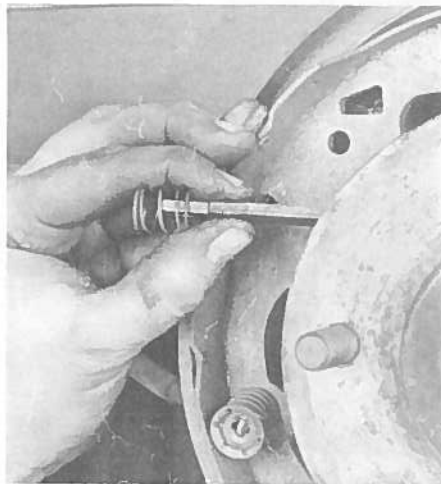
2 Release the parking brake.

3 Remove the wheel. **Note:** All four rear brake shoes must be replaced at the same time, but to avoid mixing up parts, work on only one brake assembly at a time.

4 Follow the accompanying illustrations (see illustrations 6.4a through 6.4v) for the inspection and replacement of the brake shoes. Be sure to stay in order and read the caption under each illustration. **Note:** If the brake drum cannot be easily pulled off the axle and shoe assembly,



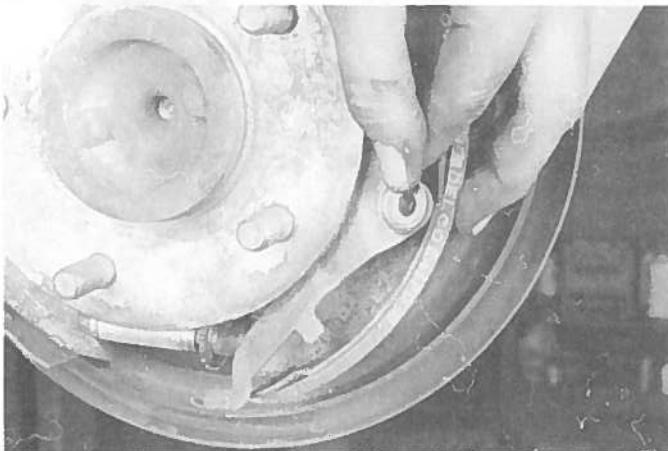
6.4d Pry the actuator lever spring out with a large screwdriver



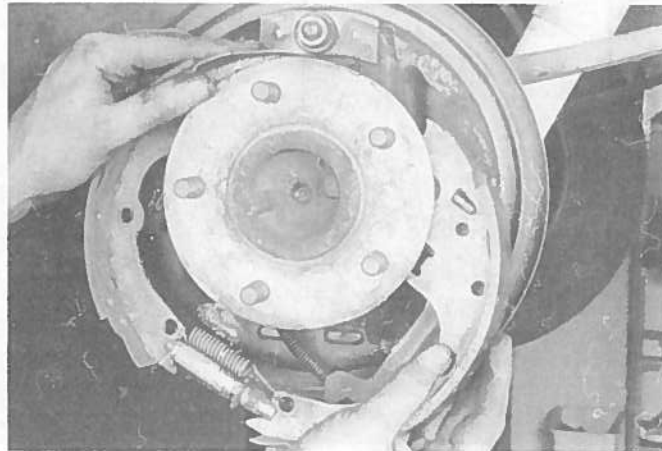
6.4e Slide the parking brake strut out from between the axle flange and primary shoe



6.4f Remove the hold-down springs and pins – the hold-down spring tool shown here is available at most auto parts stores



6.4g Remove the actuator lever and pivot – be careful not to let the pivot fall out of the lever



6.4h Spread the top of the shoes apart and slide the assembly around the axle

make sure that the parking brake is completely released, then squirt some penetrating oil around the center hub area. Allow the oil to soak in and try to pull the drum off. If the drum still cannot be pulled off, the brake shoes will have to be retracted. This is accomplished by first removing the plug from the backing plate with a hammer and chisel. With the plug removed, pull the lever off the adjusting screw wheel with one small screwdriver while turning the adjusting wheel with another small screwdriver, moving the shoes away from the drum. The drum should now come off. Replace the plug with a press-in rubber plug (available at auto parts stores).

5 Before reinstalling the drum it should be checked for cracks, score marks, deep scratches and hard spots, which will appear as small discolored areas. If the hard spots cannot be removed with fine emery cloth or if any of the other conditions listed above exist, the drum must be taken to an automotive machine shop to have it resurfaced. **Note:** Professionals recommend resurfacing the drums whenever a brake job is done. Resurfacing will eliminate the possibility of out-of-round drums. If the drums are worn so much that they can't be resurfaced without exceeding the maximum allowable diameter (stamped into the drum), then new ones will be required. At the very least, if you elect not to have the drums resurfaced, remove the glazing from the surface with medium-grit emery cloth using a swirling motion.

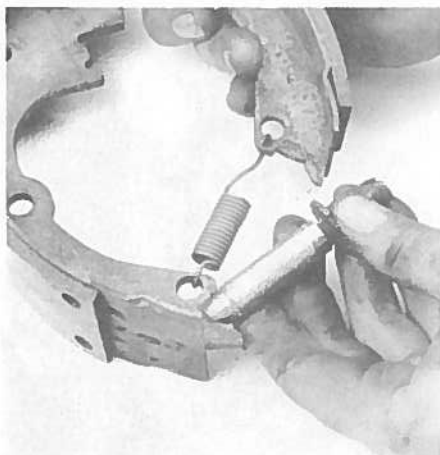
6 Install the brake drum on the axle flange.

7 Mount the wheel, install the lug nuts, then lower the vehicle.

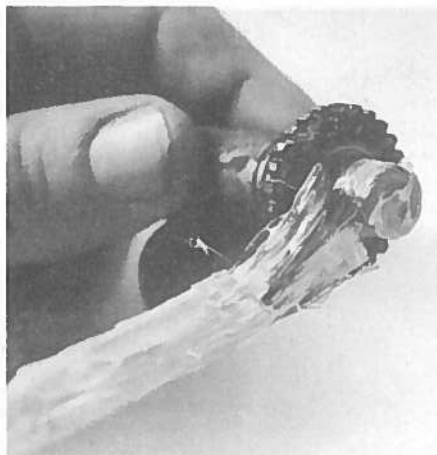
8 Make a number of forward and reverse stops to adjust the brakes until satisfactory pedal action is obtained.



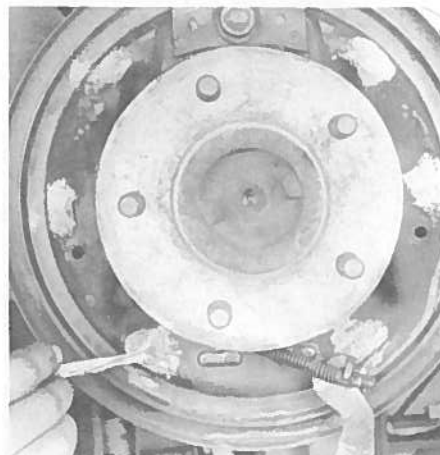
6.4i Unhook the parking brake lever from the secondary shoe – on some models you'll have to pry off an E-clip with a small screwdriver before the shoe pin will slide out of the lever – you may have to drive the pin out of the old shoe with a hammer and punch and transfer it to the new shoe



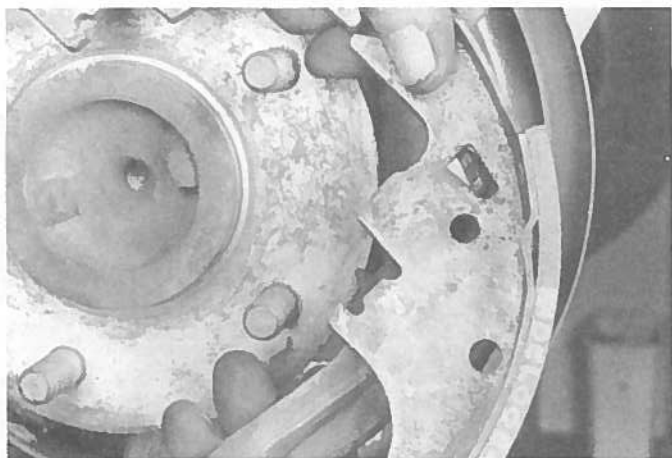
6.4j Spread the bottom of the shoes apart and remove the adjusting screw assembly



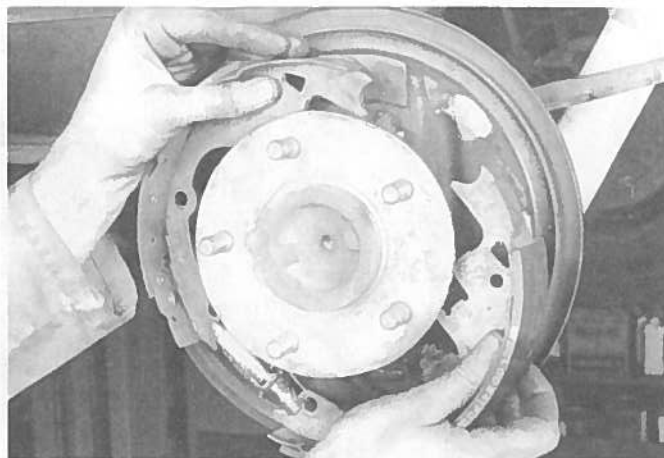
6.4k Clean the adjusting screw with solvent, dry it off and lubricate the threads and end with multi-purpose grease, then reinstall the adjusting screw assembly between the new brake shoes



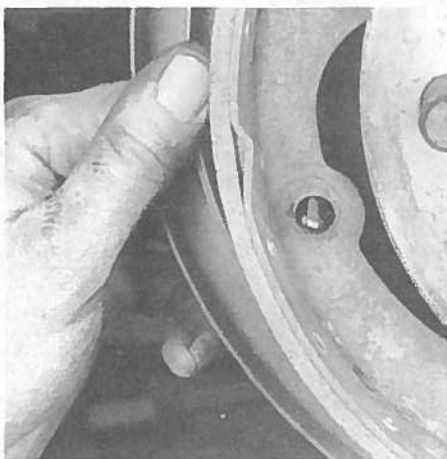
6.4l Lubricate the shoe contact points on the backing plate with high-temperature brake grease



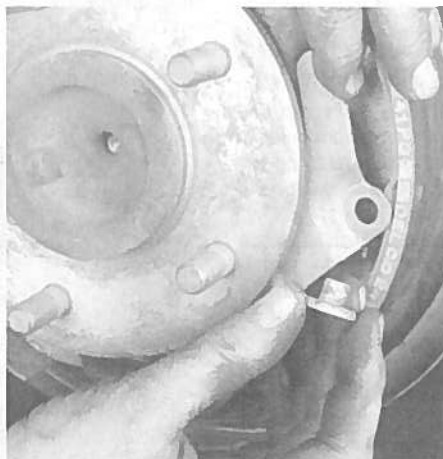
6.4m Insert the parking brake lever into the opening in the secondary brake shoe or insert the pin in the shoe through the lever and install a new E-clip



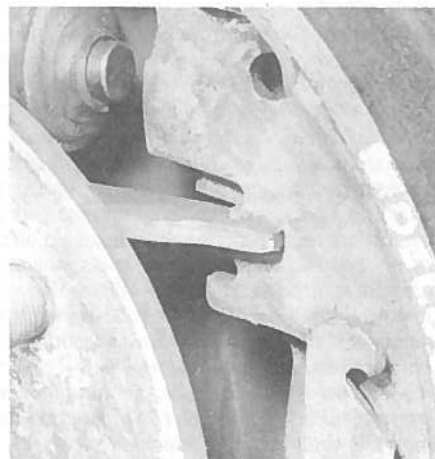
6.4n Spread the shoes apart and slide them into position on the backing plate



6.4o Install the hold-down pin and spring through the backing plate and primary shoe



6.4p Insert the lever pivot into the actuator lever, place the lever over the secondary shoe hold-down pin and install the hold-down spring



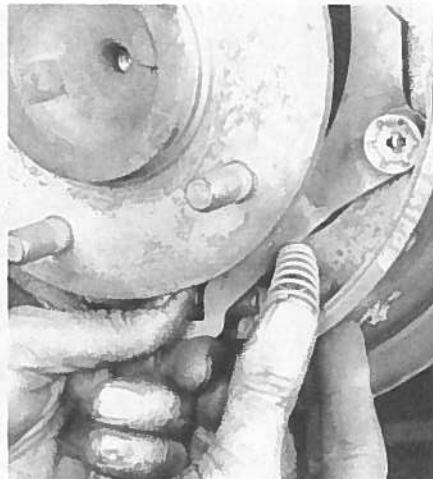
6.4q Guide the parking brake strut behind the axle flange and engage the rear end of it in the slot on the parking brake lever – spread the shoes enough to allow the other end to seat against the primary shoe



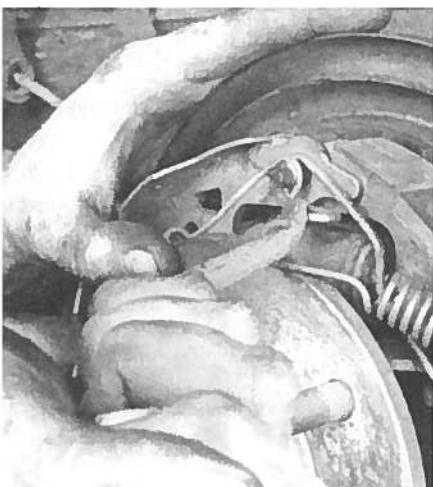
6.4r Place the shoe guide over the anchor pin



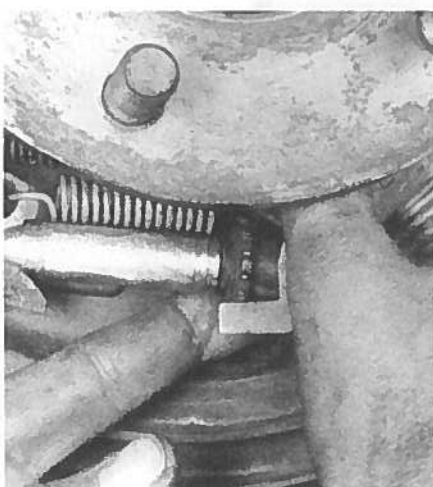
6.4s Hook the lower end of the actuator link to the actuator lever, then loop the top end over the anchor pin



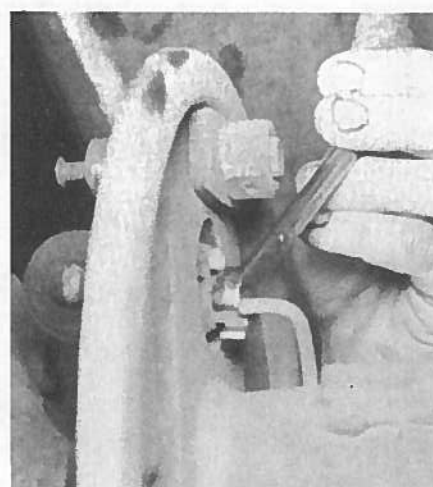
6.4t Install the lever return spring over the tab on the actuator lever, then push the spring up onto the brake shoe



6.4u Install the primary and secondary shoe return springs



6.4v Pull out on the actuator lever to disengage it from the adjusting screw wheel, turn the wheel to adjust the shoes in or out as necessary – the brake drum should slide over the shoes and turn with a very slight amount of drag



7.2 Unscrew the brake line fitting from the rear of the wheel cylinder

7 Wheel cylinder (drum brakes) – removal, overhaul and installation

Refer to illustrations 7.2, 7.3a, 7.3b, 7.3c and 7.12

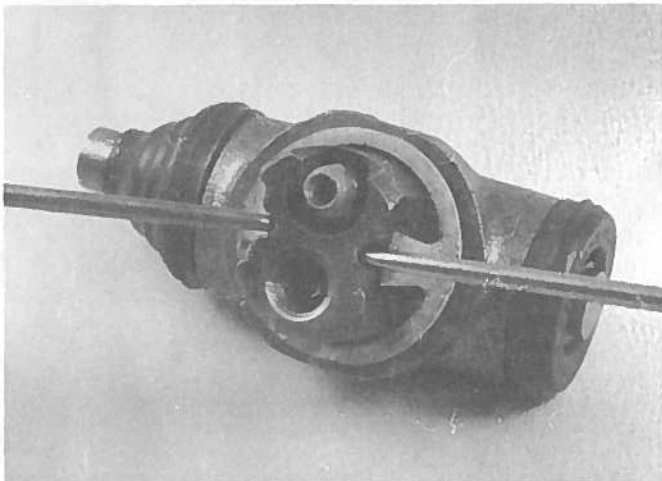
Note: Obtain the wheel cylinder rebuild kits before beginning this procedure. Complete rebuilt or new wheel cylinders are available at many auto parts stores. These may be more cost-effective than overhauling the cylinders yourself, particularly if the pistons or wheel cylinder bore is damaged.

Removal

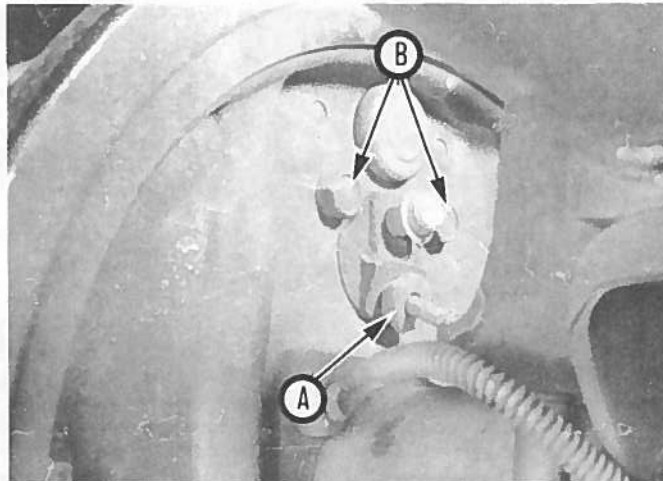
- 1 Remove the brake shoes (see Section 6).
- 2 Remove the brake line fitting from the rear of the wheel cylinder (see illustration). Cap the brake line to prevent contamination.
- 3 On 1991 and earlier models, use curved needle-nose pliers to remove the wheel cylinder retaining clip (see illustration) from the rear of the wheel cylinder. Alternatively, insert two awls into the access slots between the cylinder pilot and the retainer locking tabs and bend both tabs



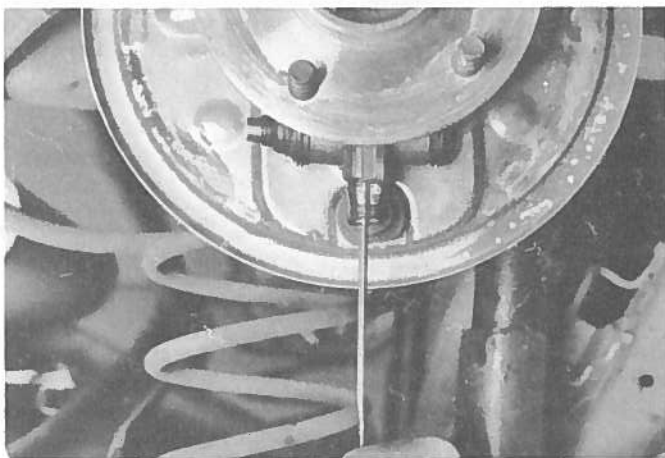
7.3a Remove the wheel cylinder retaining clip, using needle-nose pliers . . .



7.3b ... or use two awls or similar tools to remove the retaining clip as shown here (cylinder removed from backing plate for clarity)



7.3c On later model cylinders, completely loosen the brake line fitting (A), then remove the two mounting bolts (B)



7.12 Place a screwdriver handle between the wheel cylinder and axle flange to hold the cylinder in place while installing retaining clip or bolts

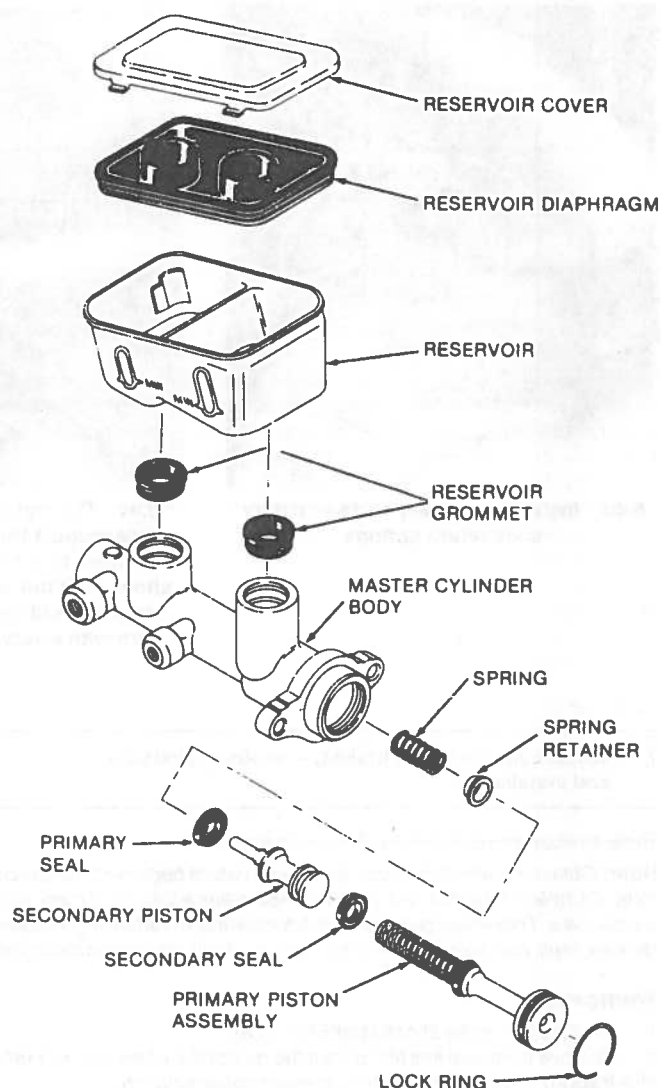
away at the same time (see illustration). On 1992 and later models, the wheel cylinder can be simply unbolted from the backing plate (see illustration).

Overhaul

- 4 Remove the cylinder and place it on a clean workbench.
- 5 Remove the bleeder valve, seals, pistons, boots and spring assembly from the cylinder body.
- 6 Clean the wheel cylinder with brake fluid, denatured alcohol or brake system cleaner. Do not, under any circumstances, use petroleum-based solvents to clean brake parts.
- 7 Use compressed air to remove excess fluid from the wheel cylinder and to blow out the passages.
- 8 Check the cylinder bore for corrosion and scoring. Crocus cloth may be used to remove light corrosion and stains, but the cylinder must be replaced with a new one if the defects cannot be removed easily, or if the bore is scored.
- 9 Lubricate the new seals with clean brake fluid.
- 10 Assemble the brake cylinder, making sure the boots are properly seated.

Installation

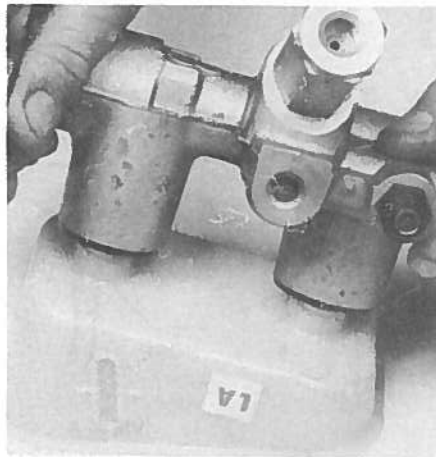
- 11 Place the wheel cylinder in position in the backing plate.
- 12 Secure the cylinder in place with a new retaining clip or bolts by first starting the brake line fitting into the threads of the wheel cylinder, and in-



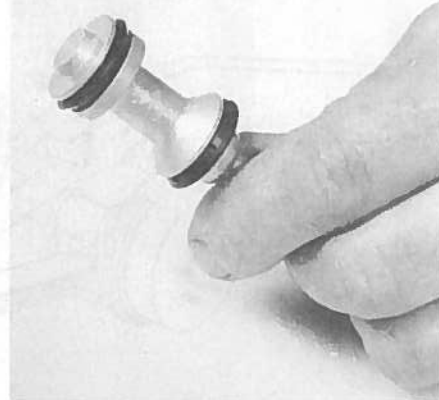
8.6 Typical brake master cylinder – exploded view



8.9 Pry the plastic reservoir from the master cylinder body



8.14 Press the master cylinder body onto the reservoir



8.15 The secondary seals must be installed with the lips facing out

installing and tightening bolts (later models) or placing a screwdriver handle between the wheel cylinder and the axle flange to hold the cylinder in place while the retaining clip is pushed into place with curved needle-nose pliers (see illustration). Make sure the clip and cylinder are securely in place, then remove the screwdriver. On all models, tighten the brake line fitting.

3 Bleed the brake system (see Section 13).

Master cylinder – removal, overhaul and installation

Refer to illustrations 8.6, 8.9, 8.14, 8.15 and 8.18

Removal

A master cylinder overhaul kit should be purchased before beginning this procedure. The kit will include all the replacement parts necessary for the overhaul procedure. The rubber replacement parts, particularly the seals, are the key to fluid control within the master cylinder. As such, it's very important that they be installed securely and facing in the proper direction. Be careful during the rebuild procedure that no grease or mineral-based solvents come in contact with the rubber parts.

1 Completely cover the front fender and cowl area of the vehicle, as brake fluid can ruin painted surfaces if it is spilled.

2 Disconnect the brake line connections. Rags or newspapers should be placed under the master cylinder to soak up the spilled fluid.

3 Remove the two master cylinder mounting nuts, move the bracket retaining the combination valve forward slightly, taking care not to bend the hydraulic lines running to the combination valve, and remove the master cylinder from the vehicle.

Overhaul

Note: Complete rebuilt master cylinders are available at many auto parts stores. These may be a more cost-effective alternative than overhaul, particularly if the cylinder bore is corroded or damaged.

1 Remove the reservoir cover and reservoir diaphragm, then discard any remaining fluid in the reservoir.

2 Remove the primary piston lock ring by depressing the piston and prying the ring out with a screwdriver (see illustration).

3 Remove the primary piston assembly with a wire hook, being careful not to scratch the bore surface.

4 Remove the secondary piston assembly in the same manner.

5 Place the master cylinder in a vise and pry the reservoir from the cylinder body with a pry bar (see illustration).

6 Do not attempt to remove the quick take-up valve from the cylinder body, as this valve is not serviceable.

7 Remove the reservoir grommets.

8 Inspect the cylinder bore for corrosion and damage. If any corrosion or damage is found, replace the master cylinder body with a new one, as abrasives cannot be used on the bore.



8.18 The primary seal must be installed with the lip facing away from the piston

13 Lubricate the new reservoir grommets with silicone brake lube and press the grommets into the master cylinder body, making sure they are properly seated.

14 Lay the reservoir on a hard surface and press the master cylinder body onto the reservoir, using a rocking motion (see illustration).

15 Remove the old seals from the secondary piston assembly and install the new seals so that the cups face out (see illustration).

16 Attach the spring retainer to the secondary piston assembly.

17 Lubricate the cylinder bore with clean brake fluid and install the spring and secondary piston assembly in the cylinder.

18 Disassemble the primary piston assembly, noting the position of the parts, then lubricate the new seals with clean brake fluid and install them on the piston (see illustration).

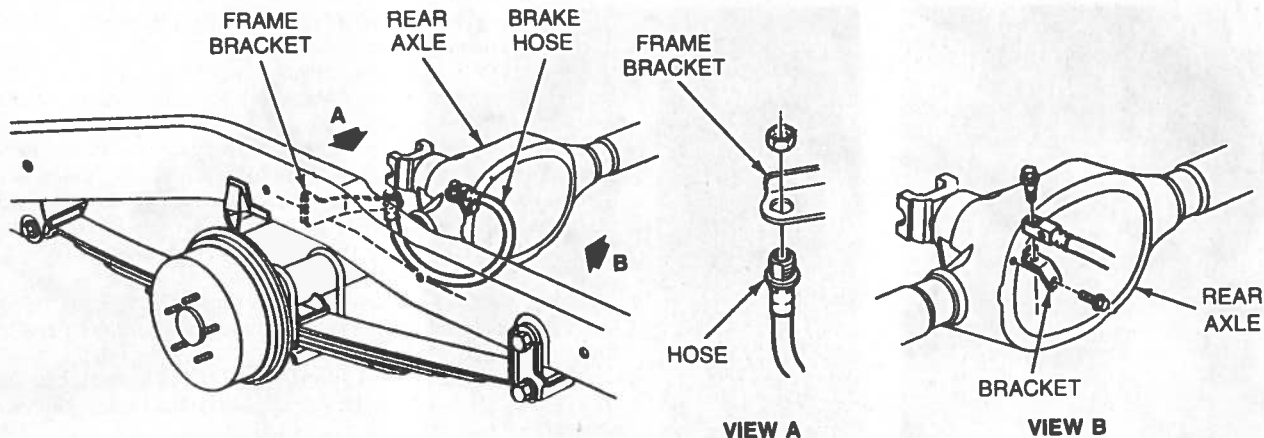
19 Install the primary piston assembly in the cylinder bore, depress it and install the lock ring.

20 Inspect the reservoir cover and diaphragm for cracks and deformation. Replace any damaged parts with new ones and attach the diaphragm to the cover.

21 **Note:** Whenever the master cylinder is removed, the complete hydraulic system must be bled. The time required to bleed the system can be reduced if the master cylinder is filled with fluid and "bench bled" (refer to Steps 22 through 25) before the master cylinder is installed on the vehicle.

22 Insert threaded plugs of the correct size into the cylinder outlet holes and fill the reservoirs with brake fluid (the master cylinder should be supported in such a manner that brake fluid will not spill out of it during the bench bleeding procedure).

23 Loosen one plug at a time and push the piston assembly into the bore to force air from the master cylinder. To prevent air from being drawn back



9.11 Typical rear brake hose routing and mounting details

into the cylinder, the appropriate plug must be tightened before allowing the piston to return to its original position.

24 Stroke the piston three or four times for each outlet to assure that all air has been expelled.

25 Refill the master cylinder reservoirs and install the diaphragm and cover assembly. **Note:** The reservoirs should only be filled to the top of the reservoir divider to prevent overflowing when the cover is installed.

Installation

26 Carefully install the master cylinder by reversing the removal steps, then bleed the brakes at the wheel bleed valves (see Section 13).

9 Hydraulic brake hoses and lines – inspection and replacement

Refer to illustration 9.11

1 About every six months, with the vehicle raised and placed securely on jackstands, the flexible hoses which connect the steel brake lines with the front and rear brake assemblies should be inspected for cracks, chafing of the outer cover, leaks, blisters and other damage. These are important and vulnerable parts of the brake system and inspection should be complete. A light and mirror will prove helpful for a thorough check. If a hose exhibits any of the above conditions, replace it with a new one as follows:

Front brake hose

- 2 Using a back-up wrench, disconnect the brake line from the hose fitting, being careful not to bend the frame bracket or brake line.
- 3 Use pliers to remove the U-clip from the female fitting at the bracket, then remove the hose from the bracket.
- 4 At the caliper end of the hose, remove the bolt from the banjo fitting then remove the hose and the copper gaskets on either side of the banjo fitting.
- 5 When installing the hose, always use new copper gaskets on either side of the banjo fitting and lubricate all bolt threads with clean brake fluid before installing them.
- 6 With the fitting flange engaged with the caliper locating ledge, attach the hose to the caliper and tighten it securely.
- 7 Without twisting the hose, install the female fitting in the hose bracket (it will fit the bracket in only one position).
- 8 Install the U-clip retaining the female fitting to the frame bracket.
- 9 Using a back-up wrench, attach the brake line to the hose fitting and tighten it securely.
- 10 When the brake hose installation is complete there should be no kinks in the hose. Also, make sure the hose does not contact any part of the suspension. Check this by turning the wheels to the extreme left and right po-

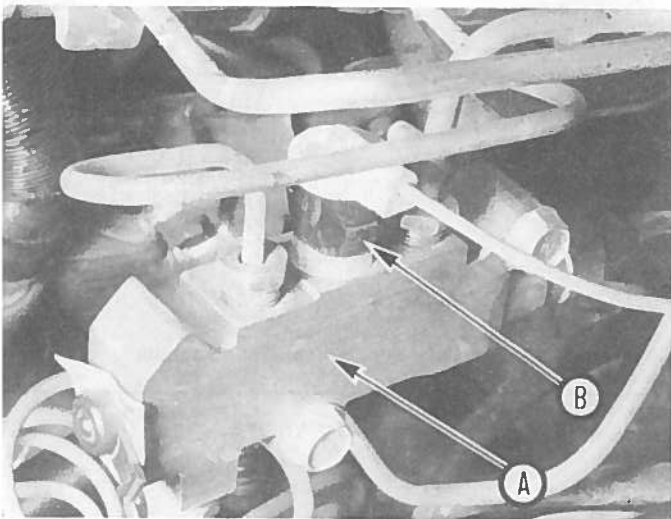
sitions. If the hose makes contact, remove the hose and correct the installation as necessary.

Rear brake hose

- 11 Locate the junction block at the rear axle and disconnect the two steel brake lines from the block (**see illustration**).
- 12 Using a back-up wrench, remove the hose at the female fitting, being careful not to bend the bracket or steel lines.
- 13 Remove the U-clip with pliers and separate the female fitting from the bracket.
- 14 Note the position of the junction block carefully so that it may be reinstalled in precisely the same position.
- 15 Remove the bolt attaching the junction block to the axle and remove the hose from the block.
- 16 When installing, thread both steel line fittings into the junction block at the rear axle.
- 17 Bolt the junction block to the axle, then tighten the block bolt and steel lines securely.
- 18 Without twisting the hose, install the female end of the hose in the frame bracket (it will fit the bracket in only one position).
- 19 Install the U-clip retaining the female end to the bracket.
- 20 Using a back-up wrench, attach the steel line fitting to the female fitting, tightening it securely. Again, be careful not to bend the bracket or steel line.
- 21 Check that the hose installation did not loosen the frame bracket. Retorque the bracket if necessary.
- 22 Fill the master cylinder reservoirs and bleed the system (see Section 13).

Steel brake lines

- 23 When it becomes necessary to replace steel lines, use only double-walled steel tubing. Never substitute copper tubing because copper is subject to fatigue cracking and corrosion. The outside diameter of the tubing is used for sizing.
- 24 Auto parts stores and brake supply houses carry various lengths of prefabricated brake line. Depending on the type of tubing used, these sections can either be bent by hand into the desired shape or be bent in a tubing bender.
- 25 If prefabricated lengths are not available obtain the recommended steel tubing and fittings to match the line to be replaced. Determine the correct length by measuring the old brake line, and cut the new tubing to length, leaving about 1/2-inch extra for flaring the ends.
- 26 Install the fittings onto the cut tubing and flare the ends using an ISO flaring tool.
- 27 Using a tubing bender, bend the tubing to match the shape of the old brake line.
- 28 Tube flaring and bending can usually be performed by a local auto parts store if the proper equipment mentioned in Steps 26 and 27 is not available.



10.1 On most models, the combination valve (A) is located just under the master cylinder, and the pressure differential switch (B) is under the center of the valve

9 When installing the brake line, leave at least 3/4-inch clearance between the line and any moving parts.

0 Combination valve (non-ABS models) – check and replacement

Refer to illustrations 10.1 and 10.15

Check

Disconnect the electrical connector from the pressure differential switch (see illustration). **Note:** When disconnecting the connector, squeeze the connector side lock releases, moving the inside tabs away from the switch, then pull up. Pliers may be used as an aid if necessary.

Using a jumper wire, connect the switch wire to a good ground, such as the engine block.

3 Turn the ignition key to the On position. The warning light in the instrument panel should light up.

4 If the warning light does not light, either the bulb is burned out or the electrical circuit is defective. Replace the bulb (see Chapter 12) or repair the electrical circuit as necessary.

5 When the warning light functions correctly, turn the ignition switch off, disconnect the jumper wire and reconnect the wire to the switch terminal.

6 Make sure the master cylinder reservoirs are full, then attach a bleeder hose to one of the rear wheel bleeder valves and immerse the other end of the hose in a container partially filled with clean brake fluid.

7 Turn the ignition switch on.

8 Open the bleeder valve while a helper applies moderate pressure to the brake pedal. The brake warning light on the instrument panel should light.

9 Close the bleeder valve before the helper releases the brake pedal.

10 Reapply the brake pedal with moderate to heavy pressure. The brake warning light should go out.

11 Attach the bleeder hose to one of the front brake bleeder valves and repeat Steps 8 through 10. The warning light should react in the same manner as in Steps 8 and 10.

12 Turn the ignition switch off.

13 If the warning light did not come on in Steps 8 and 11, but does light when a jumper is connected to ground, the warning light switch portion of the combination valve is defective and the combination valve must be replaced with a new one since the components of the combination valve are not individually serviceable.

Replacement

14 Place a container under the combination valve and protect all painted surfaces with newspapers or rags.

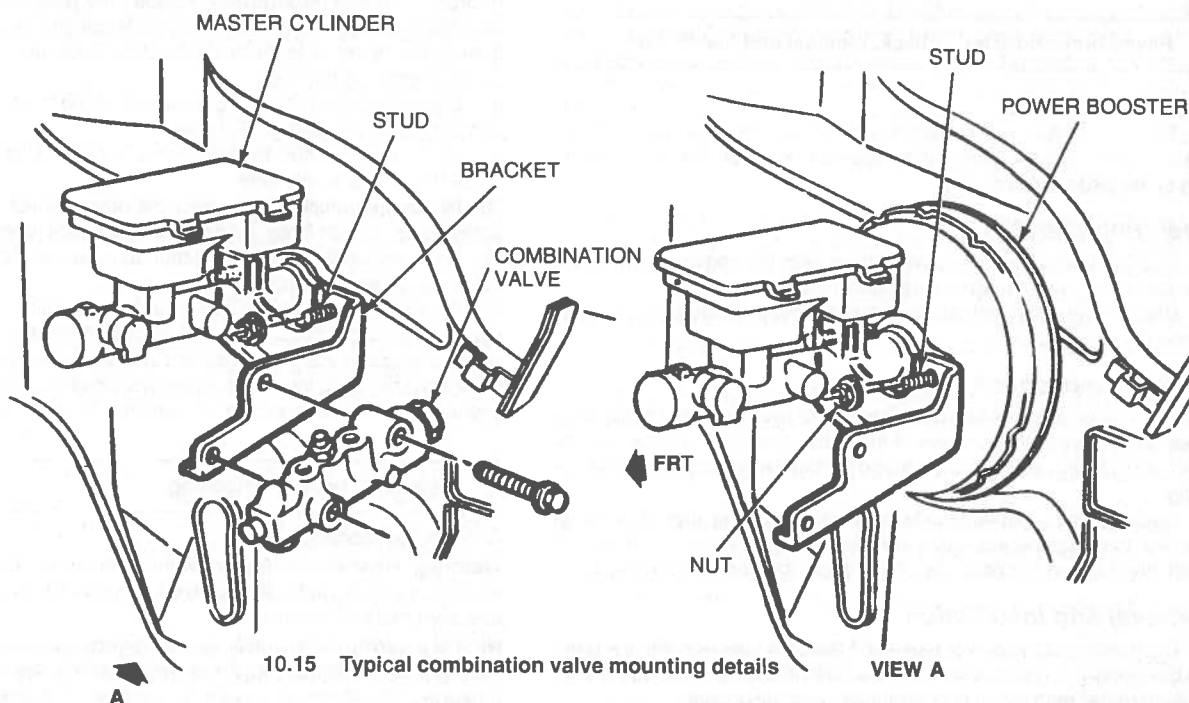
15 Disconnect the hydraulic lines at the combination valve, then plug the lines to prevent further loss of fluid and to protect the lines from contamination (see illustration).

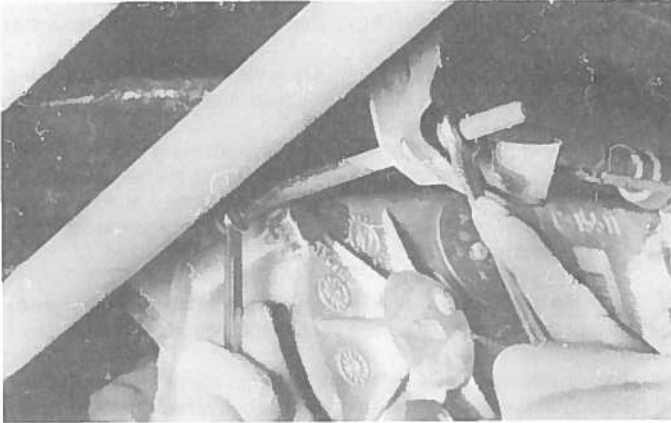
16 Disconnect the electrical connector from the pressure differential switch (refer to Step 1 if necessary).

17 Remove the bolt holding the valve to the mounting bracket and remove the valve from the vehicle.

18 Installation is the reverse of the removal procedure.

19 Bleed the entire brake system (see Section 13). Do not move the vehicle until a firm brake pedal is attained.





11.4 Use one wrench to hold the brake cable stud from turning while turning the adjusting nut with another wrench

11 Parking brake – adjustment

Refer to illustration 11.4

- 1 The parking brake cables may stretch over a period of time, necessitating adjustment. Also, the parking brake should be checked for proper adjustment whenever the rear brake cables have been disconnected. If the parking brake handle travel is less or more clicks than those listed in the Specifications Section at the beginning of this Chapter, the parking brake needs adjustment.
- 2 Apply the parking brake pedal exactly two (2WD) or three (4WD) ratchet clicks.
- 3 Raise the vehicle and support it securely on jackstands.
- 4 Locate the adjusting nut on the rear side of the equalizer bracket. To keep the brake cable stud from turning, hold it with one wrench and turn the adjusting nut with another wrench until the left rear wheel can just be turned in reverse (using two hands) but is locked when you attempt to turn it forward (see illustration).
- 5 Release the parking brake and make sure that both rear wheels turn freely and that there is no brake drag in either direction, then remove the jackstands and lower the vehicle.

12 Power brake booster – check, removal and installation

Refer to illustration 12.7

- 1 The power brake unit requires no special maintenance apart from periodic inspection of the hoses and inspection of the air filter beneath the boot at the pedal pushrod end.

Operating check

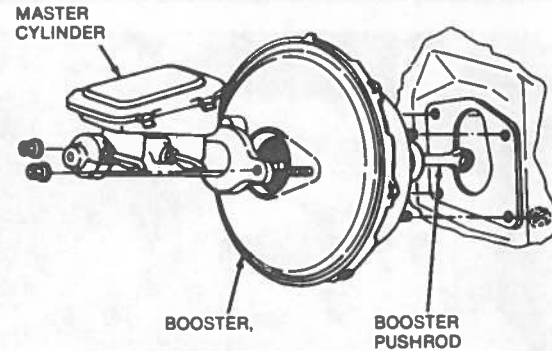
- 2 Depress the brake pedal several times with the engine off and make sure that there is no change in the pedal reserve distance.
- 3 Depress the pedal and start the engine. If the pedal goes down slightly, operation is normal.

Air tightness check

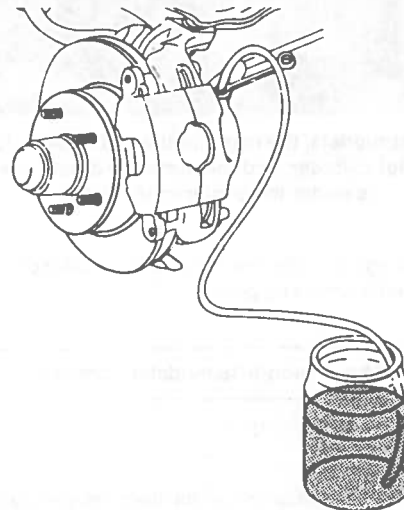
- 4 Start the engine and turn it off after one or two minutes. Depress the brake pedal several times slowly. If the pedal goes down farther the first time but gradually rises after the second or third depression, the booster is air-tight.
- 5 Depress the brake pedal while the engine is running, then stop the engine with the pedal depressed. If there is no change in the pedal reserve travel after holding the pedal for 30 seconds, the booster is air-tight.

Removal and installation

- 6 Dismantling of the power brake unit requires special tools. If a problem develops, it is recommended that a new or factory-exchange unit be installed rather than trying to overhaul the original booster.



12.7 Brake booster installation details



13.8 When bleeding the brakes, a hose is connected to the bleeder valve and then submerged in brake fluid – air will be seen as bubbles in the container and the hose

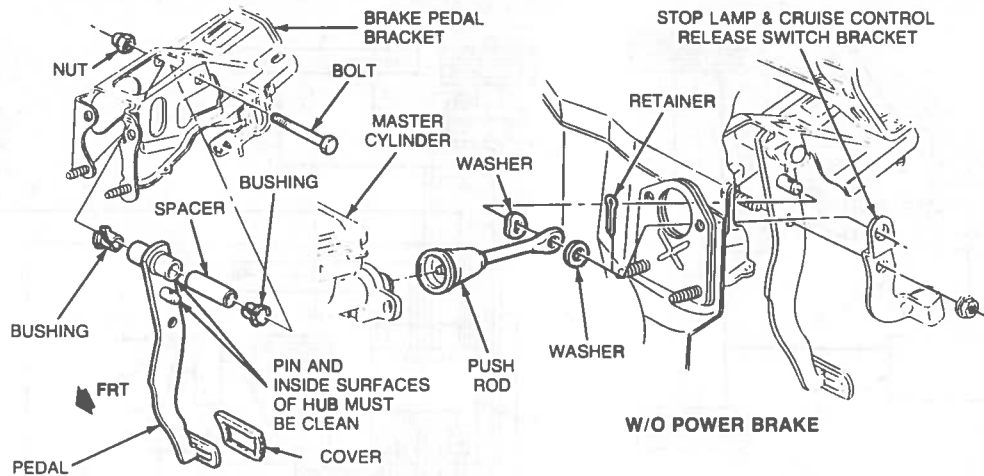
- 7 Remove the mounting nuts which hold the master cylinder to the power brake unit (see illustration). Position the master cylinder out of the way, being careful not to strain the lines leading to the master cylinder. If there is any doubt as to the flexibility of the lines, disconnect them at the cylinder and plug the ends.
- 8 Disconnect the vacuum hose leading to the front of the power brake booster. Cover the end of the hose.
- 9 Loosen the four nuts that secure the booster to the firewall. Do not remove these nuts at this time.
- 10 Inside the vehicle, disconnect the power brake pushrod from the brake pedal. Do not force the pushrod to the side when disconnecting it.
- 11 Now remove the four booster mounting nuts and carefully lift the unit out of the engine compartment.
- 12 When installing, loosely install the four mounting nuts and then connect the pushrod to the brake pedal. Tighten the nuts securely and reconnect the vacuum hose and master cylinder. If the hydraulic brake lines were disconnected, the entire brake system should be bled to eliminate any air which has entered the system (see Section 13).

13 Hydraulic system – bleeding

Refer to illustration 13.8

Warning: Wear eye protection when bleeding the brake system. If the fluid comes in contact with your eyes, immediately rinse them with water and seek medical attention.

Note 1: Bleeding the hydraulic system is necessary to remove any air that manages to find its way into the system when it's been opened during removal and installation of a hose, line, caliper or master cylinder.



14.3 Typical brake pedal mounting details

Note 2: If the EHC valve in the Four-Wheel Anti-lock (4WAL) brake system is suspected of having air in it, it must be separately bled by a dealer service department.

It will probably be necessary to bleed the system at all four brakes if air has entered the system due to low fluid level, or if the brake lines have been disconnected at the master cylinder.

If a brake line was disconnected only at a wheel, then only that caliper or wheel cylinder must be bled.

If a brake line is disconnected at a fitting located between the master cylinder and any of the brakes, that part of the system served by the disconnected line must be bled.

Remove any residual vacuum from the brake power booster by applying the brake several times with the engine off.

Remove the master cylinder reservoir cover and fill the reservoir with brake fluid. Reinstall the cover. **Note:** Check the fluid level often during the bleeding operation and add fluid as necessary to prevent the fluid level from falling low enough to allow air bubbles into the master cylinder.

Have an assistant on hand, as well as a supply of new brake fluid, a clear container partially filled with clean brake fluid, a length of 3/16-inch plastic, rubber or vinyl tubing to fit over the bleeder valve and a wrench to open and close the bleeder valve.

Beginning at the right rear wheel, loosen the bleeder valve slightly, then tighten it to a point where it is snug but can still be loosened quickly and easily.

Place one end of the tubing over the bleeder valve and submerge the other end in brake fluid in the container (**see illustration**).

Have the assistant pump the brakes slowly a few times to get pressure in the system, then hold the pedal firmly depressed.

10 While the pedal is held depressed, open the bleeder valve just enough to allow a flow of fluid to leave the valve. Watch for air bubbles to exit the submerged end of the tube. When the fluid flow slows after a couple of seconds, close the valve and have your assistant release the pedal.

11 Repeat Steps 9 and 10 until no more air is seen leaving the tube, then tighten the bleeder valve and proceed to the left rear wheel, the right front wheel and the left front wheel, in that order, and perform the same procedure. Be sure to check the fluid in the master cylinder reservoir frequently.

12 Never use old brake fluid. It contains moisture which will deteriorate the brake system components.

13 Refill the master cylinder with fluid at the end of the operation.

14 Check the operation of the brakes. The pedal should feel solid when depressed, with no sponginess. If necessary, repeat the entire process.

Warning: Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.

4 Brake pedal – removal and installation

Refer to illustration 14.3

Disconnect the cable from the negative battery terminal.

2 Disconnect the clutch pedal return spring (if equipped with a manual transmission).

3 Remove the clip retainer from the pushrod pin which travels through the pedal arm (**see illustration**).

4 Remove the nut from the pedal shaft bolt. Slide the shaft out far enough to clear the brake pedal arm.

5 The brake pedal can now be removed, along with the spacer and bushing. The clutch pedal (if equipped) will remain in place.

6 When installing, lubricate the spacer and bushings with multi-purpose grease and tighten the pivot nut to the torque listed in the Specifications Section.

15 Stop light switch – removal, installation and adjustment

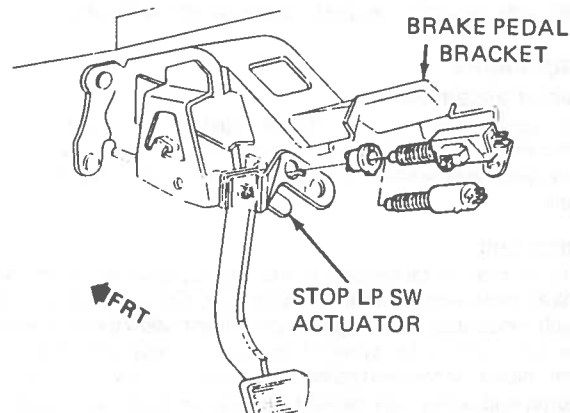
Refer to illustration 15.4

1 The switch is located on a flange or bracket protruding from the brake pedal support.

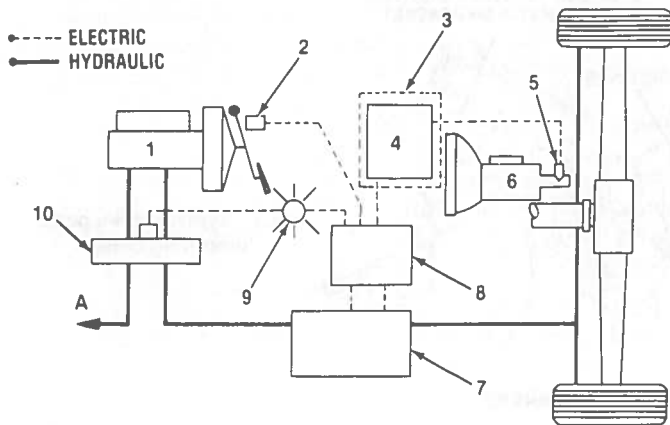
2 With the brake pedal in the fully released position, the plunger on the body of the switch should be completely pressed in. When the pedal is pushed in, the plunger releases and sends electrical current to the stop lights at the rear of the vehicle.

3 If the stop lights are inoperative and it has been determined that the bulbs are not burned out, push the stop light switch into the tubular clip, noting that audible clicks can be heard as the threaded portion of the switch is pushed through the clip toward the brake pedal.

4 Pull the brake pedal all the way to the rear against the pedal stop until no further clicks can be heard (**see illustration**). This will seat the switch in the tubular clip and provide the correct adjustment.



15.4 Stop light installation details



16.4a Rear Wheel Anti-lock (RWAL) brake system diagram

- | | |
|----------------------------------|------------------------|
| A To front brakes | 5 Speed sensor |
| 1 Master cylinder | 6 Transmission |
| 2 Brake light switch | 7 Isolation/dump valve |
| 3 Instrument cluster | 8 RWAL Control Module |
| 4 Digital ratio adapter | 9 Brake warning light |
| (part of the instrument cluster) | 10 Combination valve |

5 Release the brake pedal and repeat Step 4 to ensure that no further clicks can be heard.

6 Make sure that the stop lights are working.

7 If the lights are not working, disconnect the electrical connectors at the stop light switch and remove the switch from the clip.

8 Install a new switch and adjust it by performing Steps 3 through 6, making sure the electrical connectors are hooked up.

16 Anti-lock Brake System (ABS) – general information

Refer to illustration 16.4a and 16.4b

Description

The Anti-lock brake system is designed to maintain vehicle maneuverability, directional stability and optimum deceleration under severe braking conditions on most road surfaces. It does so by monitoring the rotational speed of the wheels and controlling the brake pressure during braking. This prevents the wheels from locking up prematurely.

Two types of systems are used: Rear Wheel Anti-lock (RWAL) and Four Wheel Anti-Lock (4WAL). RWAL only controls lockup on the rear wheels, whereas 4WAL prevents lockup on all four wheels.

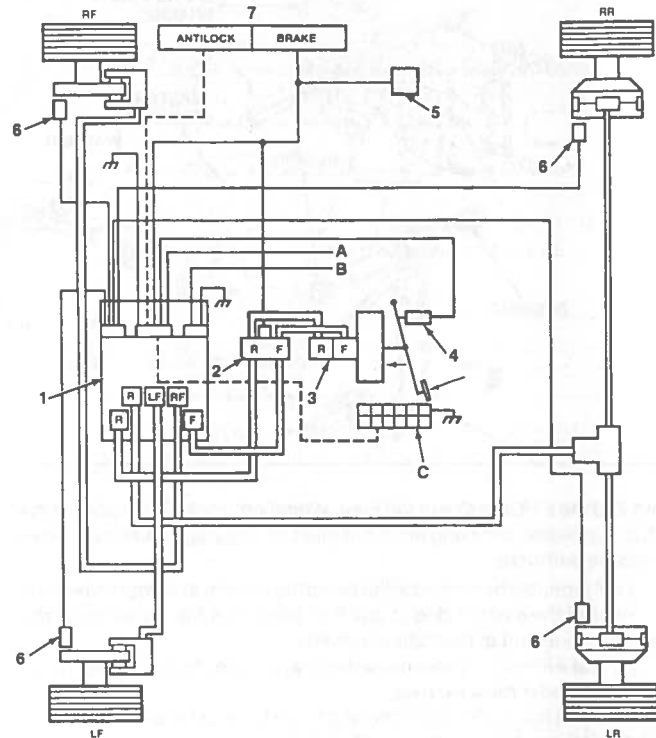
Components

Actuator assembly

The actuator assembly includes the master cylinder and control valve which consists of a dump valve and an isolation valve. The valve operates by changing the brake fluid pressure in response to signals from the control unit.

Control unit

The control unit for the anti-lock brakes is called the Control Module on RWAL and Electro-Hydraulic Control Unit (EHC) on 4WAL systems. The unit is mounted in the engine compartment below the master cylinder and is the "brain" for the system (see illustrations). The function of the control unit is to accept and process information received from the speed sensor(s) and brake light switch to control the hydraulic line pressure, avoiding wheel lockup. The control unit also constantly monitors the system, even under normal driving conditions, to find faults within the system.



16.4b Four-Wheel Anti-Lock (4WAL) brake system diagram

- | | |
|---------------------------|------------------------|
| A To ignition switch (B+) | 3 Master cylinder |
| B To battery B+ | 4 Brake pedal switch |
| C ALDL | 5 Parking brake switch |
| 1 4WAL EHC valve | 6 Wheel speed sensors |
| 2 Combination valve | 7 Warning lights |

If a problem develops within the system the BRAKE (RWAL system) or ANTI-LOCK (4WAL system) warning light on the dashboard will glow. A diagnostic code will also be stored, which, when retrieved by a technician, will indicate the problem area or component.

Speed sensor

On RWAL systems, a rear wheel speed sensor is located in the transmission extension housing on 2WD models or in the transfer case on 4WD models. On 4WAL systems, a speed sensor is located at each wheel. These sensors send a signal to the control unit, indicating wheel speed.

Brake light switch

The brake light switch signals the control unit when the driver steps on the brake pedal. Without this signal the anti-lock system won't activate.

Diagnosis and repair

If the dashboard BRAKE or ANTI-LOCK warning light comes on and stays on, make sure there's no problem with the brake hydraulic system. If that's not the cause, the anti-lock system is probably malfunctioning. Although special test procedures are necessary to properly diagnose the system, the home mechanic can perform a few preliminary checks before taking the vehicle to a dealer service department.

- Make sure the brakes, calipers and wheel cylinders are in good condition.
- Check the electrical connectors at the control unit.
- Check the fuses
- Follow the wiring harness to the speed sensor(s) and brake light switch and make sure all connections are secure and the wiring isn't damaged.

If the above preliminary checks don't rectify the problem, first try to identify the area of trouble using the trouble codes in the next section, then take the vehicle to a dealer service department.



17.2 ALDL terminal details – connect a jumper between the A and H terminals to access the brake codes

7 ABS system trouble codes – general information and retrieval

Refer to illustration 17.2

The on-board computer that operates the RWAL or 4WAL system also has a built-in diagnostic feature. This feature allows you to pinpoint a problem because the computer detects faults and stores them as trouble codes, which can then be easily retrieved. While it may not be possible for the home mechanic to repair all of these faults, the codes can allow you to be better informed when explaining a problem to the mechanic.

Every time the vehicle is started, the system checks itself and the BRAKE/ANTILOCK light on the dash comes on, then goes off when the check is completed.

When a code is stored, the light on the dash will light and stay on. The codes can then be retrieved and displayed. These codes are represented as flashes, indicating the problem area or component in the system.

Retrieving codes

- 1 Locate the ALDL connector under the dash.
- 2 Connect a jumper wire between the H and A terminals (see illustration). After about 20 seconds the codes will flash on the BRAKE/ANTILOCK light. Write down the codes as they are displayed. Once the codes are retrieved, check them against the chart for your vehicle. Two-digit codes will consist of a long and short flash. Begin counting each code with the long flash (include the long flash in the count). If there is more than one ABS system failure, only the first code recognized will be stored.

Clearing codes

- 3 After codes have been retrieved and repairs made, they should be cleared from the ECU memory.

RWAL system

- 4 With the ignition Off, remove the "Brake" fuse from the fuse block for at least five seconds, then reinstall it.

4WAL system

- 5 Turn the ignition switch On, install the jumper wire between the H and A terminal for two seconds, remove it for one second, then install it for two seconds. The ANTILOCK/BRAKE light should light, then go off.

4WAL system

Trouble codes	Circuit or system	Probable cause
Code 1 (1 flash)	ECU	Faulty Electronic Control Unit (ECU).
Code 2 (2 flashes)	Isolation valve, ECU	The isolation valve is stuck or the ECU is faulty.
Code 3 (3 flashes)	Pressure dump valve or ECU	The dump valve is stuck open or the ECU is faulty.
Code 4 (2 flashes)	Anti-lock valve switch	The anti-lock valve is stuck open.
Code 5 (5 flashes)	Pressure dump valve	If the rear brake anti-lock action is excessive during hard braking, the pressure dump valve could be faulty.
Code 6 (6 flashes)	Speed sensor	Erratic brake action at low speeds and pedal pressure is a sign of a fault in the speed sensor or speedometer circuit.
Code 7 (7 flashes)	Isolation valve, ECU	Isolation valve short circuited or ECU faulty.
Code 8 (8 flashes)	Dump valve, ECU	Dump valve short circuit or ECU faulty.
Code 9 (9 flashes)	Speed sensor circuit	Open in the speed sensor circuit or a faulty speedometer.
Code 10 (10 flashes)	Brake light switch circuit	The brake light switch is faulty or needs adjustment.
Code 11 (1 flash, pause, 1 flash)	ECU	Faulty Electronic Control Unit (ECU).
Code 12 (1 flash, pause, 2 flashes)	ECU	Faulty Electronic Control Unit (ECU).
Code 13 (1 flash, pause, 3 flashes)	ECU	Faulty Electronic Control Unit (ECU).
Code 15 (1 flash, pause, 5 flashes)	ECU	Faulty Electronic Control Unit (ECU).

4WAL system

Trouble codes	Circuit or system	Probable cause
Code 21 (2 flashes, pause, 1 flash)	Right front wheel circuit	Faulty wheel sensor or open circuit.
Code 22 (2 flashes, pause, 2 flashes)	Right front wheel circuit	No signal. Remove the wheel. Check for a damaged sensor or loose electrical connectors.
Code 23 (2 flashes, pause 3 flashes)	Right front wheel circuit	Intermittent signal, indicating a loose electrical connector.
Code 25 (2 flashes, pause, 5 flashes)	Left front wheel circuit	No signal. Remove the wheel. Check for a damaged sensor or a loose electrical connector.
Code 26 (2 flashes, pause, 6 flashes)	Left front wheel circuit	Intermittent signal, indicating a loose electrical connector.
Code 27 (2 flashes, pause, 7 flashes)	Left front speed sensor circuit	Faulty sensor or loose electrical connector.
Code 28 (2 flashes, pause, 8 flashes)	Speed sensor signal	Erratic brake action at low speeds and pedal pressures indicates a fault in the speed sensor circuit or speedometer.
Code 29 (2 flashes, pause, 9 flashes)	EHCUCircuit	A loss of signal from all four sensors indicates a loose EHCUCircuit connector.
Code 31 (3 flashes, pause, 1 flash)	Right rear speed sensor circuit	An intermittent code indicates a loose electrical connector.
Code 32 (3 flashes, pause, 2 flashes)	Right rear wheel circuit	No signal. Remove the wheel and check for a damaged sensor and loose connectors.
Code 33 (3 flashes, pause, 3 flashes)	Right rear wheel circuit	The signal is intermittent, indicating a loose electrical connector.
Code 35 (3 flashes, pause, 5 flashes)	Left rear wheel circuit	The signal is intermittent. Check for a loose connection or faulty sensor unit.
Code 36 (3 flashes, pause, 6 flashes)	Left rear speed sensor circuit	No signal. Remove the wheel and check the sensor wheel for damage and the sensor for a loose or damaged connection.
Code 37 (3 flashes, pause, 7 flashes)	Left rear speed sensor circuit	An inconsistent anti-lock action at low speeds and pedal pressure is a sign of a fault in the speed sensor unit or connectors.
Code 38 (3 flashes, pause, 8 flashes)	EHCUCircuit valve circuit	A pulsing pedal indicates a defective wheel sensor or faulty EHCUCircuit valve.
Codes 41 through 66	4WAL control unit or motor circuit	Check for a loose ground connection at the motor circuit. Clear the code and drive the vehicle. If any of these codes return, the EHCUCircuit valve may be faulty.
Codes 71 through 74	4WAL control unit	Clear the code and drive the vehicle. If any of these codes return, the EHCUCircuit valve may be faulty.
Code 67 (6 flashes, pause, 7 flashes)	Motor circuit	Check the motor for loose electrical connections.
Code 68 (6 flashes, pause, 8 flashes)	Motor circuit	A locked motor or an open circuit. Check the motor for loose electrical connections.
Code 81 (8 flashes, pause, 1 flash)	Brake switch circuit	Make sure the driver hasn't been riding the brake. Check the brake switch adjustment and electrical connections.
Code 86 (8 flashes, pause, 6 flashes)	Anti-lock warning light	Check the light and wiring for a short circuit.
Code 88 (8 flashes, pause, 8 flashes)	Brake warning light	Check the light and wiring for a short circuit.